

Building skills and knowledge using research reactors

By Nicole Jawerth

Students perform real-time laboratory experiments remotely by connecting to a classroom at the RA-6 research reactor in Argentina.

(Photo: P. Cantero/CNEA)



Research reactors are an important resource for training nuclear professionals worldwide, but only around a quarter of countries have their own research reactors.

“Not having a research reactor doesn’t need to limit a country’s options when it comes to educating and training nuclear professionals. There is now a variety of possibilities,” said Christophe Xerri, Director of the IAEA’s Division of Nuclear Fuel Cycle and Waste Technology.

To help ensure that students and nuclear professionals can get the education and training they need, whether their country has a research reactor or not, the IAEA supports international training courses, both on-the-ground and remotely, as well as facilitates collaboration between countries to increase access to research reactors.

A research reactor is a nuclear reactor that, instead of generating power, is primarily used to produce neutrons. Although research reactors are mainly used for research and applications, they also play a major part in the education and training of budding and established professionals who work in nuclear facilities, radiation protection and nuclear regulation.

“Research reactors offer a hands-on way to gain a deeper understanding of the fundamental principles behind reactor operation, and, given how they are designed, they can be used

to safely simulate different types of reactor conditions, which is not possible with a nuclear power reactor,” said David Sears, a senior safety officer at the IAEA.

Connecting online

For students of physics and nuclear engineering, experiments using a research reactor are a key learning tool. However, being physically present at a research reactor is not always possible, especially when a student’s country does not have a research reactor. This gap is now being bridged by alternatives such as the IAEA’s Internet Reactor Laboratory (IRL) project. Established in 2015, the IRL offers a cost-effective, practical component to the training of both students and professionals by connecting classrooms anywhere in the world to classrooms associated with operating research reactors via the Internet. This allows the participants to engage in live reactor physics experiments and learn more about reactor operations.

“When I got involved in the IRL in 2018, I had already learned a lot about reactors, but I had never seen one before,” said José David Cremé Angel Bello, who is now a professor and researcher at the Atomic and Molecular Physics Department at the Higher Institute of Technologies and Applied Sciences in Cuba. “The IRL project was an amazing experience for my training as a nuclear engineer because we don’t have a nuclear reactor in Cuba, so

this allowed me to see and practice what we had studied in theory, to interact with a nuclear reactor in real time and to do experiments. It helped to prepare me for my career.”

Cremé was a nuclear engineering student when he benefited from the IRL project set up through an agreement between the IAEA and Argentina’s National Atomic Energy Commission (CNEA). The agreement was signed in 2013 and formed the basis for the IRL project in Latin America, which was one of the first IRL projects, in addition to an IRL project with France. Although the IRL project with France ended with the host reactor’s permanent shutdown, IRL projects have since expanded into Africa, Asia and the Pacific and Europe, with host reactors in the Czech Republic, the Republic of Korea and Morocco, and new hosts are now being considered in other parts of Europe and Southeast Asia.

On-the-ground training

While the IRL offers remote access to education using research reactors, on-the-ground, face-to-face training courses organized by the IAEA continue to offer an important avenue for building skills, knowledge and networks. For decades, the IAEA has supported and coordinated training for hundreds of students, young professionals and established specialists. These courses cover topics such as operation and maintenance, regulatory safety inspections, nuclear security and physical protection and application-specific uses, such as radioisotope production for medicine and materials testing for industry.

“It’s an invaluable experience to visit a research reactor and perform some experiments and feel what it’s like to operate a research reactor,” said Luka Snoj, a reactor physicist at Slovenia’s Jozef Stefan Institute, who is also involved in an IAEA group fellowship training course called the Eastern European Research Reactor Initiative (EERRI). This initiative involves a six-week course for young professionals that focuses on all aspects of research reactors.

“Many EERRI course attendees use their experience and contacts from these kinds of courses to go back to their countries and become successful scientists and engineers. In some cases, they become leading nuclear experts in their countries,” Snoj said.

“For us as a host, the EERRI has been an important way to increase the international visibility of our reactor and has allowed us to make contacts in the field for long-term collaboration, scientific visits and training.” The EERRI is one of several IAEA-supported activities, with others including regional courses and research reactor schools in Africa, Asia and the Pacific and Latin America.

For more advanced training, as well as to facilitate wider access to research reactors for scientific work, the IAEA launched the IAEA-designated International Centre based on Research Reactor (ICERR) scheme in 2014. As part of the scheme, major research centres around the world volunteer to proactively offer international cooperation opportunities. For a country to access an ICERR, it must become an affiliate by signing a bilateral agreement with an ICERR. The IAEA facilitates this process by, for example, sharing information on the capabilities offered by ICERRs.

“The ICERR scheme plays an important role not only in training operators but also in facilitating access to the research reactors that are best suited to specific types of experiments,” Xerri said. There are ICERRs in Belgium, France, the Republic of Korea and Russia, and two in the USA.

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— José David Cremé Angel Bello,
former IAEA Internet Reactor
Laboratory participant, Cuba

Get online to learn more

E-learning courses developed by the IAEA are useful resources that complement education and training related to research reactors. These courses are available on topics such as:

- Introduction for research reactor personnel (also in Spanish)
- Neutron activation analysis
- Nuclear analytical techniques for forensic science
- Operational radiation protection and waste management
- Regulatory inspection programmes
- Safety of research reactors
- Strategic planning for national nuclear institutions